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(71) Applicant: ROCKWELL INTERNATIONAL CORPORATION
1200 N. Alma Road
Richardson Texas 75081 (US)

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(72) Inventor: Strathman, Lyle R.
294 Thunderbird Road
Cedar Rapids Iowa 52403 (US)

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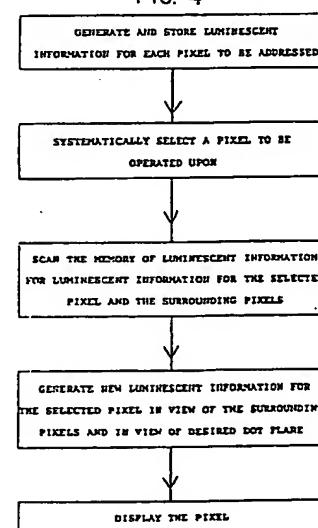
(73) Harwood, Craig E.
1801 6th Avenue SE
Cedar Rapids Iowa 52403 (US)

(74) Representative: Jackson, David Spence et al
REDDIE & GROSE 16, Theobalds Road
London, WC1X 8PL (GB)

(54) Automatic synthetic dot flare for matrix addressed displays.

(57) To enhance the image quality of displays upon matrix displays, the luminescence information for a desired pixel, to be displayed, is transformed to have a new intensity or luminescence figure and the intensity or luminescent figures of the nearby pixels are also transformed in a fashion which would emulate a gaussian luminescence or intensity distribution or any other distribution where the intensity decreases radially from the desired pixel position. The pixels are subsequently displayed with the new intensity or luminescence figure.

FIG. 4



Description**AUTOMATIC SYNTHETIC DOT FLAIR FOR MATRIX ADDRESSED DISPLAYS**

This invention generally relates to matrix displays and more particularly concerns a technique to enhance the image quality of matrix displays.

Presently, across the display industry, there is a significant effort underway to increase the image quality and positional resolution of characters upon matrix displays. Typically, monochrome matrix displays consist of a regular patterned array of separately addressable single color display elements, while color matrix displays typically consist of a regular patterned array of separately addressable elements with each element corresponding to one of the three preferred colors; red, green, and blue. Typically, matrix addressed displays exhibit very sharp pixel quantization boundaries which produce visually noticeable picture chatter or jumping when displaying dynamic images; non dynamic images typically exhibit noticeable and sometimes annoying stair stepping or jagged effects. The dynamic chatter and stair stepping problems typically associated with the matrix displays can be acute on color matrix displays, where like colored dots are separated by several dot spaces of unlike colored dots. Tri-colored displays can sometimes be rendered unacceptable, with regard to visual performance, unless very high resolution i.e. very high dot densities are incorporated into the display. However, as the resolution of the matrix display increases, the dot area or dot size decreases thereby increasing the likelihood of the display of very narrow lines which can be often annoying to the human eye. Additionally, the cost of the display increases with increases in display resolution.

Consequently, the need exists for an improved technique for displaying both dynamic and non dynamic images on color matrix displays, which will decrease stair stepping and jagged edges without requiring an increase in the display resolution and thereby producing the annoying effects of very narrow line widths.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a technique for increasing the image quality for color matrix displays.

It is a feature of the present invention to operate on each pixel which is to be illuminated and generate a new luminescence which is a function of the surrounding pixel luminescence.

It is an advantage of the present invention to create a smoother line and thereby to minimize the stair stepping or jagged effects along with minimizing the picture chatter or jumping.

It is another object of the present invention to provide a high resolution color matrix display having enhanced image quality.

It is another feature of the present invention to selectively energize a group of pixels, with varied intensities, so as to create a virtual dot image which

is not co-located with the center of the group of pixels.

It is another advantage of the present invention to increase the positional resolution of dots displayed on a color matrix display.

The present invention provides an automatic synthetic dot flair technique which is designed to satisfy the aforementioned needs, provide the previously propounded objects, include the above described features and produce the earlier articulated advantages. The invention comprises a technique where the gaussian distribution, which is associated with a CRT beam, is emulated to some degree in addressing the individual pixels of a color matrix display. Although any distribution can be achieved with this technique.

Accordingly, the present invention relates to a technique for selectively energizing with varying intensities, a group of pixels positioned about a desired image dot position.

According to one aspect of the present invention a technique for displaying dots on a matrix display comprises the steps of:

- a. determining the desired pixel position;
- b. determining the luminescent information for the pixel;
- c. establishing a systematic plurality of pixels surrounding the desired pixel; and
- d. generating new luminescent information for the desired pixel position.

According to another aspect of the present invention a technique for displaying a dot at a predetermined matrix address location comprises the steps of activating a predetermined plurality of pixels surrounding the predetermined location with luminescence which decreases with distance radially from the predetermined location.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more fully understood by reading the following description of the preferred embodiments of the invention in conjunction with the accompanying drawings wherein:

Fig 1a is a schematic representation of a prior art matrix display dot imaging technique, together with a representation of the brightness versus position along the matrix as a result of the displayed dot.

Fig 1b is a schematic representation of a matrix display which utilizes the present invention and is shown with numerals concentric about a central pixel, which indicate the suggested relative intensity for each adjacent pixel, together with an intensity versus position plot as a result of the display of the central dot and the associated pixels.

Fig 2a is a schematic representation of a matrix display of the prior art showing a color/luminescent/address dot set which is not

co-located with the particularly identified colored pixel on a color matrix flat panel display.

Fig 2b is a schematic representation of a matrix display of the present invention showing a color/luminescent/address dot set not co-located with the particularly identified color dot on a color matrix display. The activated pixels are represented with circles.

Fig 3 is a representation of a logical flow diagram of the luminescence data corresponding to rows Y-M to Y+M and their conversion to the output luminescence L'_{xy} .

Fig 4 is a flow diagram of the steps of the present invention.

DETAILED DESCRIPTION

Referring now to the drawings and more particularly to Fig 1a there is shown a schematic representation of a prior art technique used upon a monochrome matrix display wherein the image dot to be displayed is achieved by activating a single pixel which is co-located with the desired image dot position.

Fig 2a is a schematic representation of a color matrix display which utilizes a prior art technique where the desired image dot is displayed by activating the dot most closely positioned to the desired image dot.

In accordance with the present invention, a desired pixel, to be displayed, is transformed to have a new intensity or luminescence figure and the intensity or luminescent figures of the nearby pixels are transformed in a fashion which emulates a gaussian luminescence or intensity distribution or any other distribution where the intensity decreases radially from the desired pixel position, and Fig 1b is a schematic representation of a monochrome matrix display which utilizes the inventive technique where a desired image dot is displayed by activating a central pixel and a plurality of concentric pixels located there about with decreasing levels of intensities so as to relatively emulate a gaussian or other radially decreasing distribution about the desired image dot position.

Now referring to Fig 2b there is shown a schematic representation of a color matrix display which utilizes the technique of the present invention whereby the desired image dot, which is not co-located over an appropriate pixel, is caused to be displayed upon the color matrix display by activating a group of pixels surrounding the desired image spot and illuminating them at variable intensities in order to produce a virtual image dot at the desired image dot position.

Now referring to Fig 4 there is shown a flow diagram of the steps of the present invention. Before an image can be displayed on prior art displays it is first required to generate and store luminescent information for each pixel to be addressed. This information is frequently put into a refresh memory associated with the displays. The present invention operates upon the luminescent information, which is typically generated for most displays, and then

develops new transformed luminescent information for each pixel to be addressed. The second step, basically, is to systematically select a pixel to be operated on. The next step is to scan the refresh memory of luminescent information for the selected pixel and the surrounding pixels. The number and configuration of the surrounding pixels which are scanned can be varied depending upon the precise requirements for any particular implementation. In a preferred example, the step of establishing a systematic plurality of pixels surrounding the desired pixel comprises determining the pixels in a 3 x 3 square configuration with the desired pixel located in a central position. The next step is to generate new luminescent information for the selected pixel in view of the surrounding pixels and further in view of the desired dot flair. The dot flair may be fashioned after and emulating a gaussian distribution around the central pixel, but other configurations or distributions may be substituted depending upon the precise design requirements of a particular implementation. After the selected pixel has had its luminescent information transformed it then can be displayed.

Now referring to Figure 3 there is shown a logic flow diagram of the luminescence data corresponding to rows Y-M to Y+M and their conversion of the output luminescence L'_{xy} . Figure 3 represents the luminescent data which would be scanned in order to operate upon the luminescence data for position xy as is shown. The data for rows Y-M and Y+M would be scanned along with the row for Y while the columns X-N through X+N would be sampled for each of the rows. The function generator generates new luminescent information for the selected pixel in view of the other luminescent information for the surrounding pixels and further in view of the desired dot flair distribution.

It is thought that the automatic synthetic dot flair technique of the present invention and many of its intended advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction, and arrangement of the parts thereof without departing from the spirit and scope of the invention, or sacrificing all of their material advantages, the forms hereinbefore described being merely preferred or exemplary embodiments thereof. It is the intention of the appended claims to cover all such changes.

This application relates to the subject matter of our co-pending European patent application no. entitled "Method and Apparatus for Drawing High Quality Lines On Color Matrix Displays" filed on the same date herewith and under our representative's reference 29698.

60 Claims

1. A technique for displaying dots on a matrix display comprising the steps of:
a. determining the desired pixel position;

- b. determining the luminescent information for the pixel;
c. establishing a systematic plurality of pixels surrounding the desired pixel; and
d. generating new luminescent information for the desired pixel position.
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2. A technique according to Claim 1, characterised in that the establishing a systematic plurality of pixels surrounding the desired pixel further comprises determining the pixels in a 3 x 3 square configuration with the desired pixel located in a central position.
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3. A technique according to Claim 2, characterised in that the generating the new luminescent information further comprises generating luminescent information which emulates a gaussian luminescence distribution for and about the desired pixel position.
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4. A technique for displaying a dot at a predetermined matrix address location comprising the steps of activating a predetermined plurality of pixels surrounding the predetermined location with luminescence which decreases with distance radially from the predetermined location.
5. A technique according to Claim 4, characterised by the predetermined group of pixels surrounding the predetermined location being activated with intensities in a gaussian distribution.

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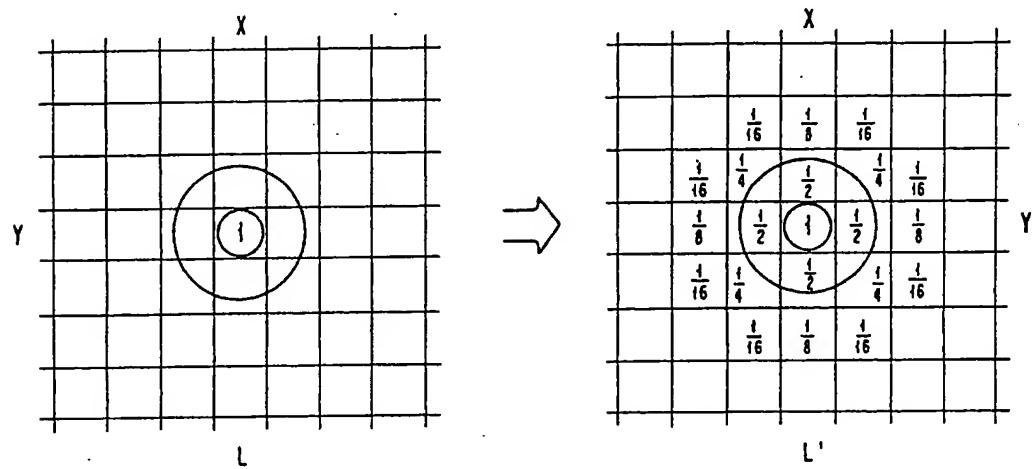


FIG 1a

FIG 1b

FIG 2a

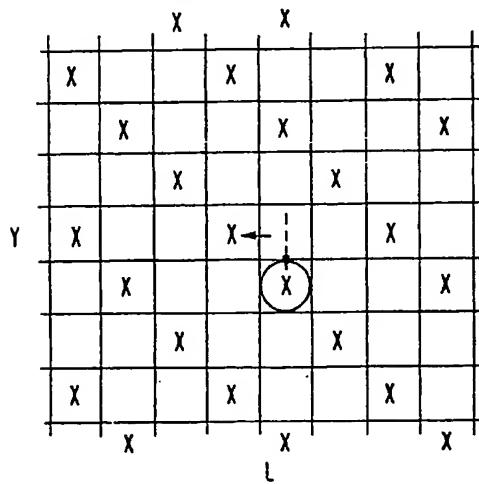
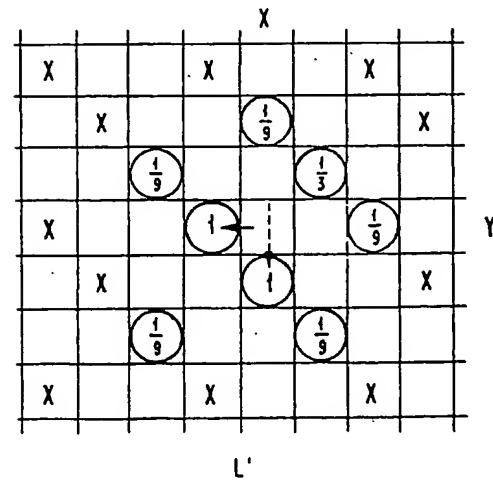


FIG 2b



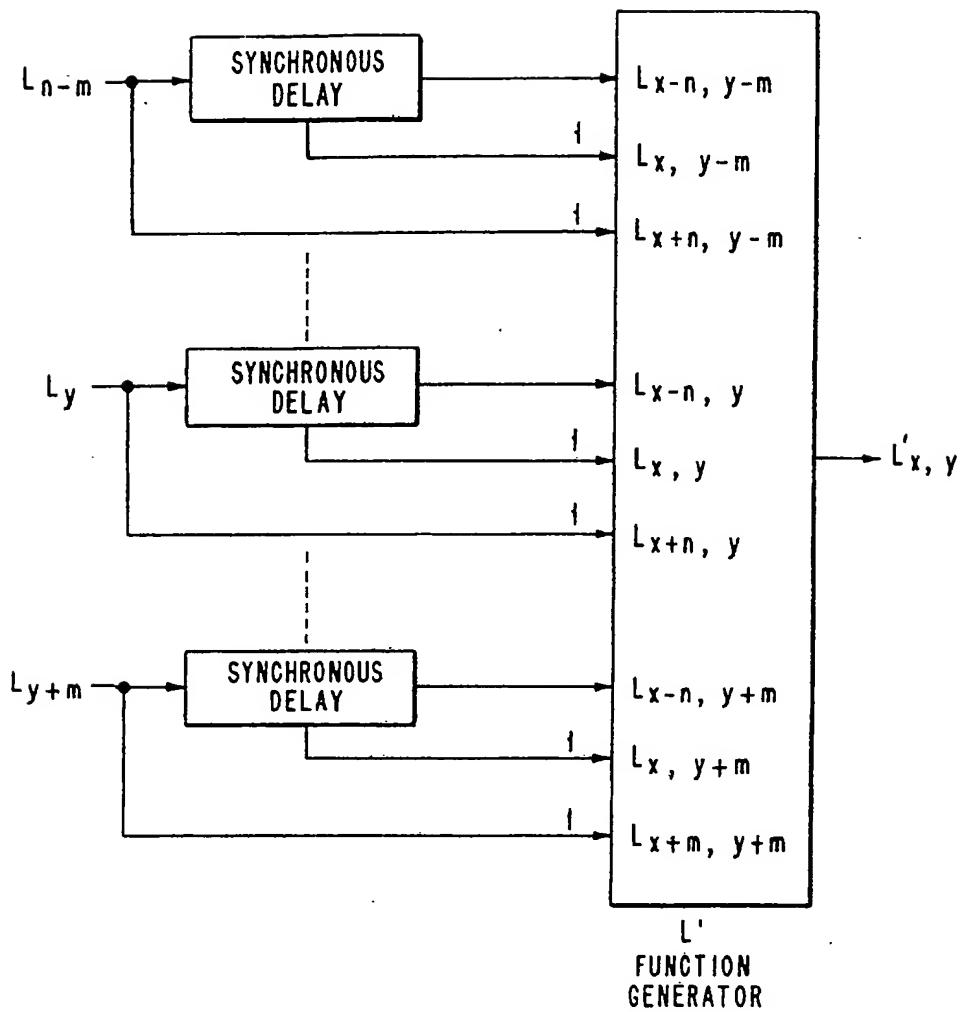


FIG 3

FIG. 4

